Electronic Supplementary Material (ESI) for Polymer Chemistry.

Supporting Information

In-situ PET-RAFT polymerization to prepare guanidine-and-carbohydrate modified ZnO nanoparticles

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Synthesis of monomers

Synthesis of the sugar monomer 2-(methacrylamino)glucose **(MAG)**: 5 g of D-(+)-glucosamine hydrochloride (0.0232 mol) and 3.2 g of potassium carbonate (0.0232 mol) were dissolved in 125 mL of absolute methanol in a 250 mL round-bottom flask. Then stir in a -15°C low-temperature stirrer for 20 min. Pipette 1.8 mL of methacryloyl chloride (2.15 g, 0.02 mol) and slowly add dropwise to a round-bottom flask. Continue the reaction in a -15 °C cryogenic stirrer for 30 min, followed by 3 h at room temperature. After 3 hours, the filtrate was swirled until no droplets of the condenser tube fell. The liquid after rotary evaporation was separated and purified by column chromatography, and a mixture of dichloromethane and absolute ethanol with a volume ratio of 4:1 was used as the eluent, and the product was removed by rotary evaporation again, and the product was collected and dried in vacuum at 25 °C overnight.

Synthesis of guanidine monomer guanidine methacryloyl chloride hydrochloride **(MAGH)**: guanidine hydrochloride (9.9 g) was added to a water (25 mL) solution of sodium hydroxide (8.3 g); The aqueous solution was stirred in an ice bath for 20 minutes. Slowly add methacryloyl chloride (10 mL) dropwise to the mixture and stir for 3 hours, always maintaining ice bath conditions. The upper organic layer was extracted by ethyl acetate extraction, and the organic layer was dried and filtered on anhydrous sodium sulfate. Ethyl acetate was removed by rotary steaming, the product was dissolved with acetone, a sufficient amount of hydrochloric acid was added dropwise, and stirred at room temperature for 2 h. The solid product is washed twice by acetone filtration and then vacuum-dried overnight at 25°C.

Synthesis of polymers

We employed our previously developed method by native ZnO.[1] Polymers were synthesized in the 48-well plate decorated with native ZnO, under simulated sunlight (light intensity = 4.7 mw·cm^{-2}@420nm).

In a typical experiment, 58 mg of MAGH (0.7 mM) and 0.5 mg of CPADB (3.5 μM) were dissolved in 1 mL of water, and polymerized for 6 h. After polymerization, the reaction solution was taken out of the well and dialyzed in water for 48 hours to remove unreacted monomers and then lyophilized to obtain polymer.

Supplementary Figures and Data

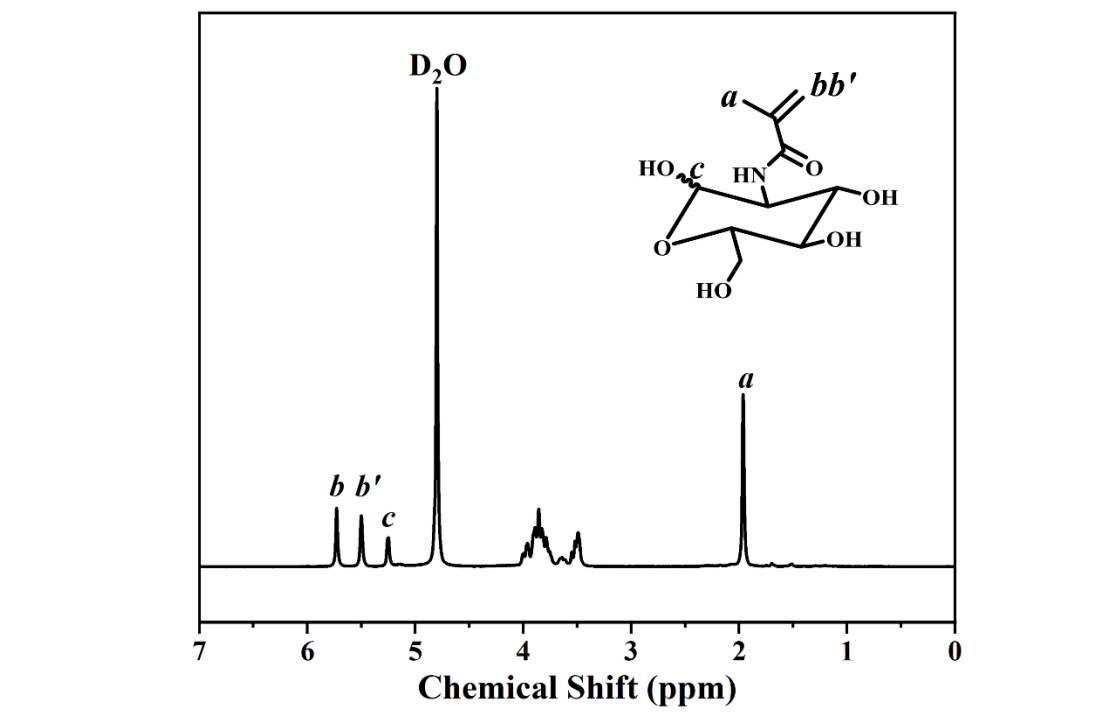

Fig. S1. ^{1}H NMR of MAG

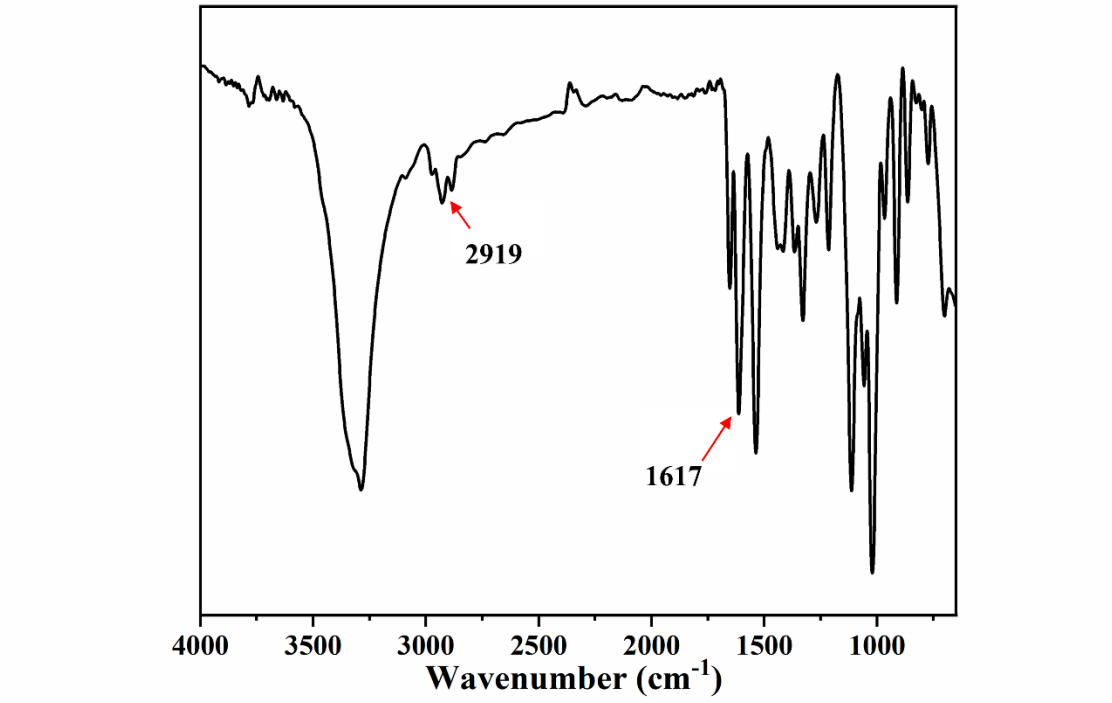

Fig. S2. FTIR spectra of MAG

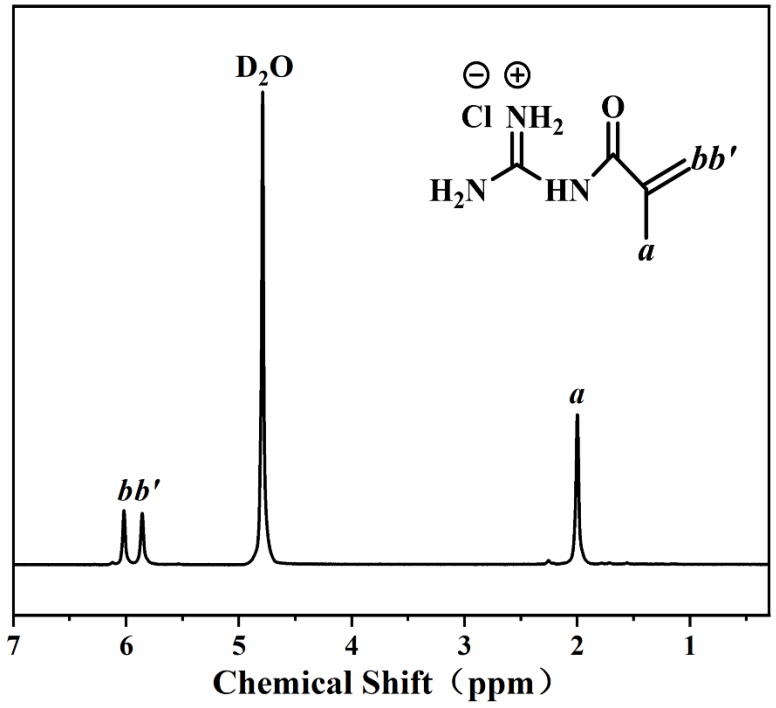

Fig. S3. ^{1}H NMR of MAGH

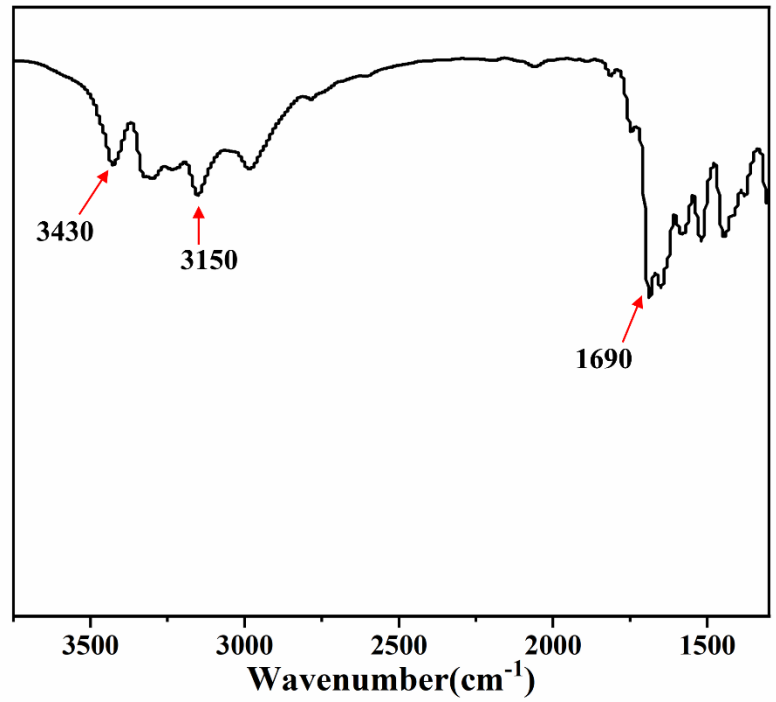

Fig. S4. FTIR spectra of MAGH

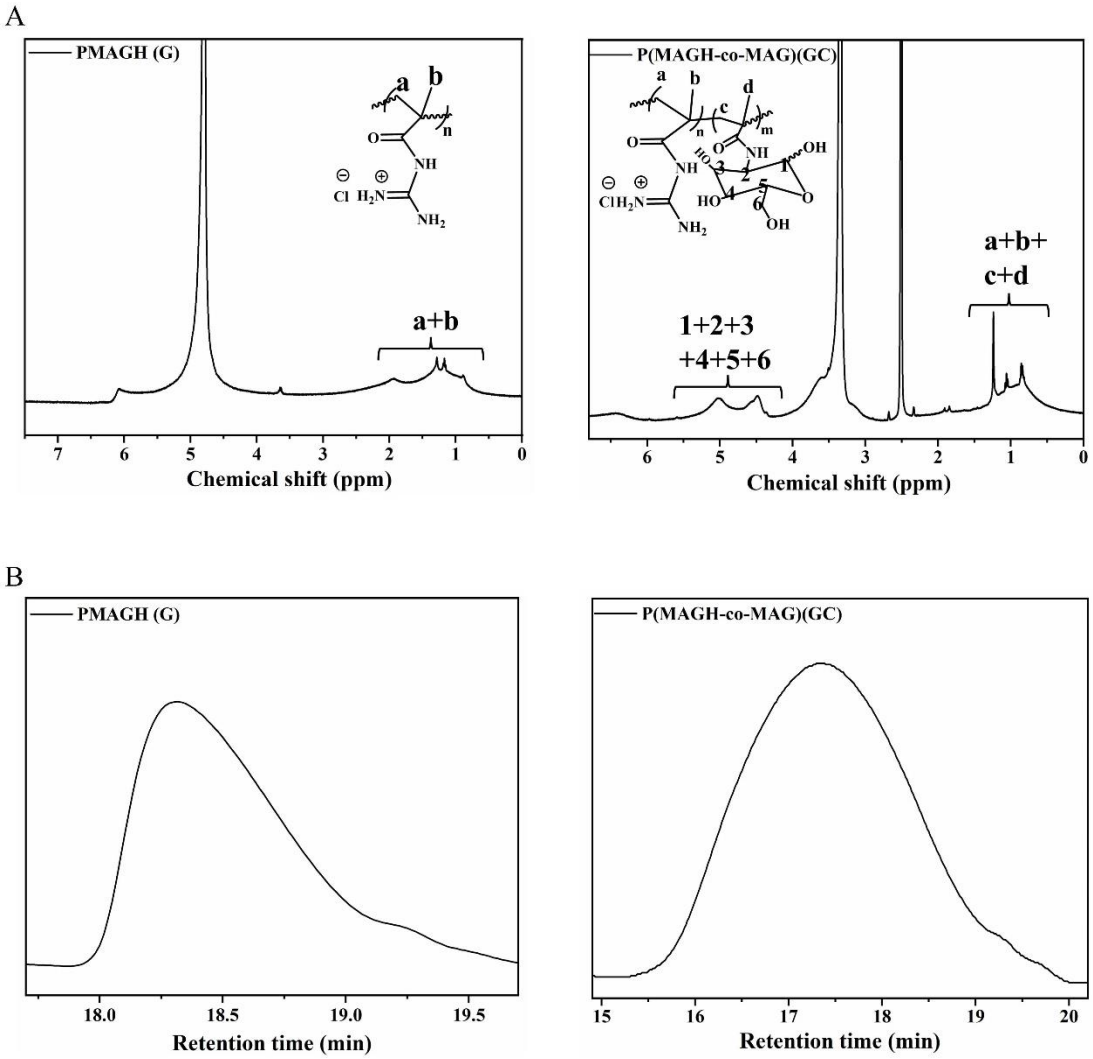

Fig. S5. (A) 1H NMR of PMAGH (G) in D2O and P(MAGH-co-MAG) (GC) in DMSO-d6. (B) SEC traces of PMAGH (G) and P(MAGH-co-MAG) (GC), Mobile phase: 0.3 mol/L sodium acetate, pH 3.0. Flow rate: 1 mL/min. Temperature: 35 °C.

Table S1. Characterization of polymers of MAGH and MAG.

Polymer	$[M]_0$: $[CPADB]_0$	Time [h]	Conv.[a] [%]	$M_{n,\,GPC}$ [b] [g·mol^{-1}]	Đ[b]
PMAGH (G)	200:1	6	18.6%	2600	1.21
P(MAGH-*co*-MAG) (GC)	100:100:1	6	33.7%	4900	1.37

[a] Calculated by gravimetry. [b] Measured by GPC using 0.3 mol/L sodium acetate, pH 3.0 as a fluent (1 mL·min^{-1}).

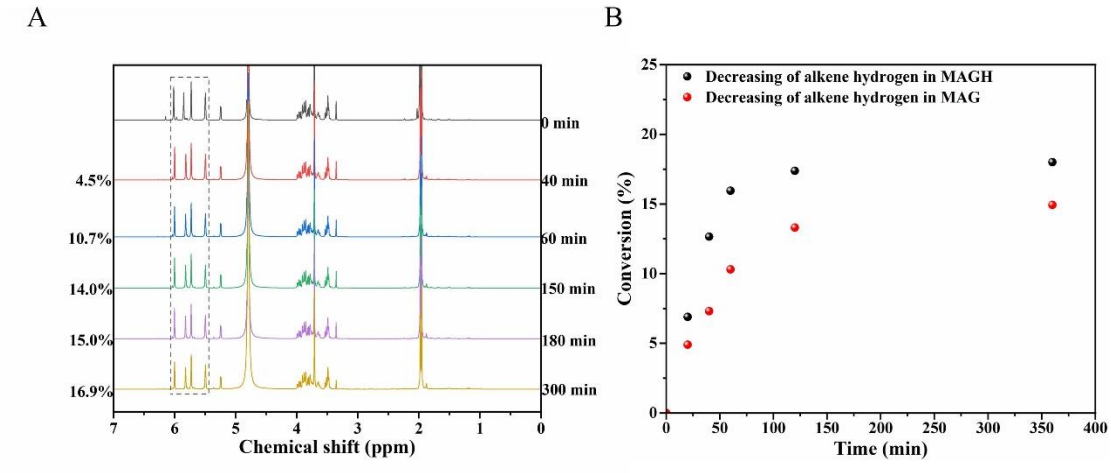

Fig. S6. (A) 1H NMR of reaction solution for the synthesis of ZnO-GC at different polymerization time in D2O. (B) Conversion of MAGH and MAG over time during the synthesis of ZnO-GC.

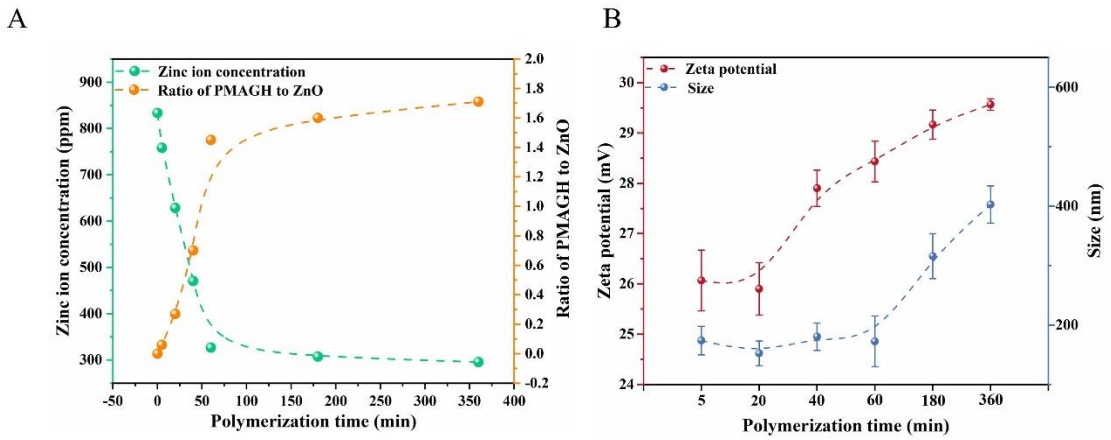

Fig. S7. (A) ICP-OES of Zn2+ and weight ratio of PMAGH to ZnO with different polmerization time. (B) Zeta potential of ZnO-G with different polymerization time.

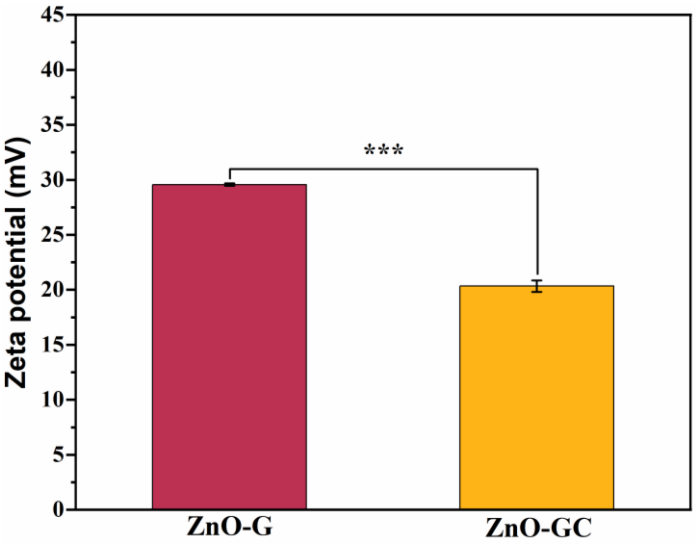

Fig. S8. Zeta potential of ZnO-G and ZnO-GC.

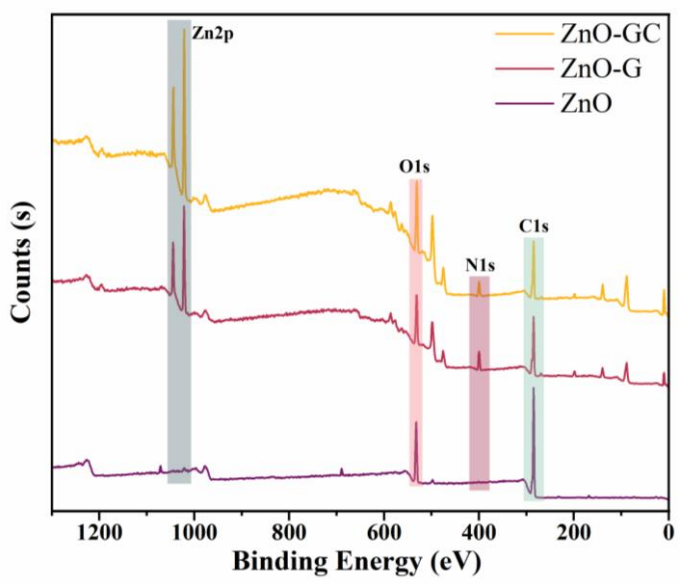

Fig. S9. XPS of ZnO, ZnO-G and ZnO-GC.

Sample	XPS atomic concentration(%)			
	C	N	O	Zn
ZnO-G	58.14	11.36	21.08	9.42
ZnO-GC	50.84	7.5	28.21	13.45

Table.S2. Atomic concentrations from EDS

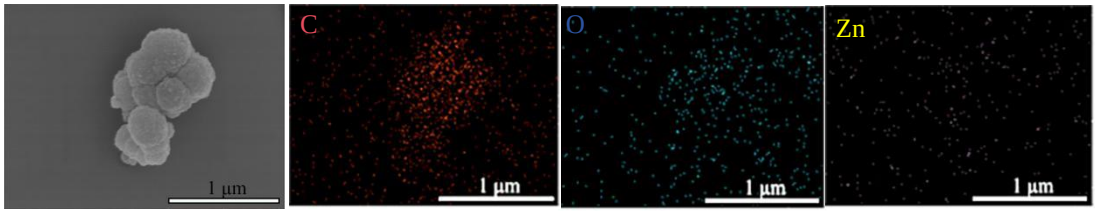

Fig. S10. SEM-EDS images of ZnO-G

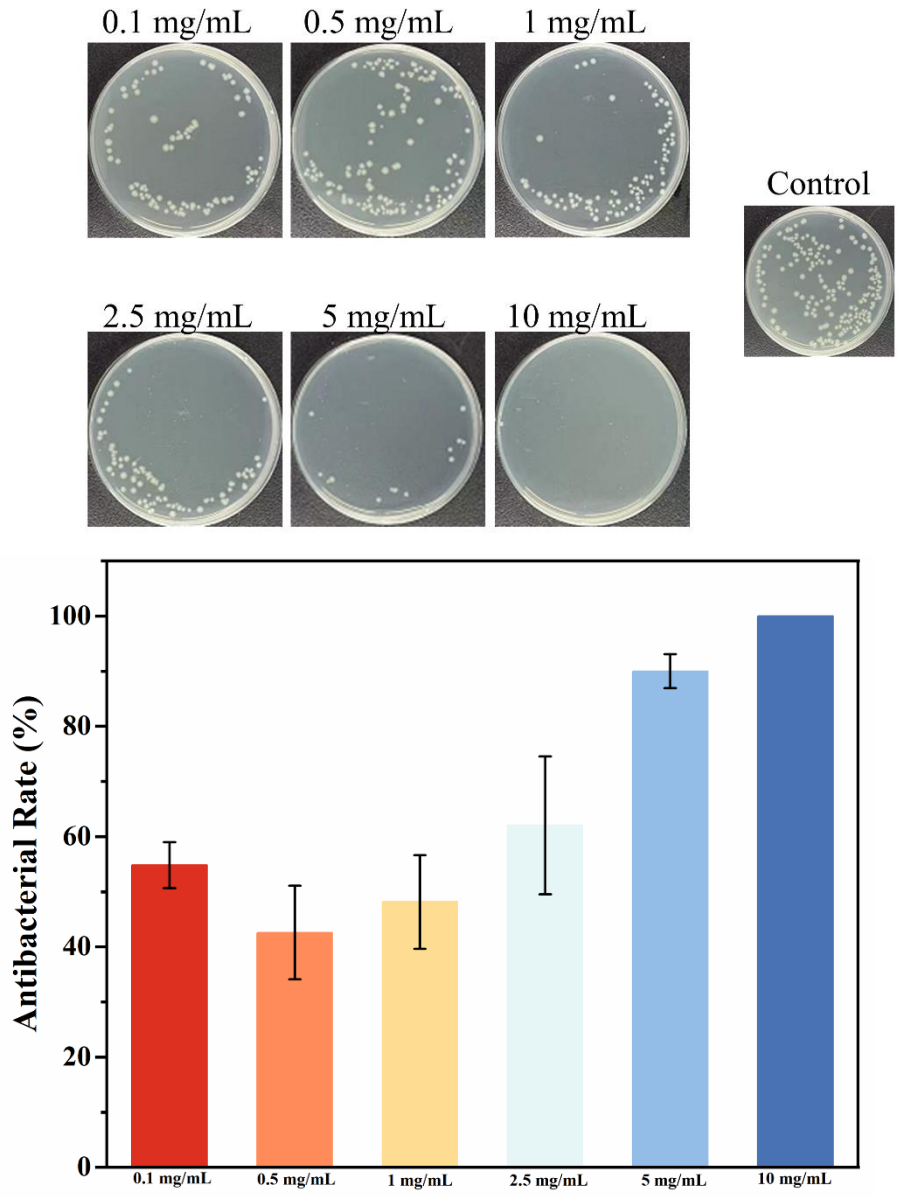

Fig. S11. Antibacterial effect of ZnO with different concentration. Data are reported as mean ± SD (n = 3).

1. Y. Zhou, C. Gu, L. Zheng, F. Shan and G. Chen, *Polymer Chemistry*, 2022, **13**, 989-996.